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The construction of Dynamical Negotiation Networks depending on need for cognitive closure

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ABSTRACT

When people communicate, they create shared representations of reality—a common ground of meaning. This article concerns mapping the dynamic process through which people create such common ground during an interaction. The Dynamic Negotiation Network methodology allows us to investigate the structure of shared understanding that negotiators come to as they reach an agreement through interaction. We also look at how negotiator characteristics can influence communication and, in effect, the shared reality that is generated. Our preliminary qualitative findings suggest that individuals who have a high need for cognitive closure, that is, who are eager to maintain their way of viewing the world, create more complex meaning structures when communicating than do people whose need for cognitive closure is low, that is, who are more flexible in negotiating the form a shared reality should take. Complex structures are characterized by more skewed distributions of connections between elements. The communication contexts we use are transcriptions of a dyadic negotiation simulation.

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1. Introduction

People communicate with each other; this is one of the essential elements of human life. Communication can have a number of positive consequences that provide an adaptive advantage from an evolutionary perspective, but also serve as a basis for humanity's further development, as a mean for the creation and propagation of culture, a sense of community, establishment of legal systems etc. Communication is thus a process that has been shaped over the course of human history (Hodges, 2014) and is deeply embedded in biological, social, and historical contexts (Rączaszek-Leonardi, 2010). In order to communicate effectively, common ground must be established (Clark and Brennan, 1991). The process of constructing common ground (and the ultimate form this common ground takes) may be different depending on the individual predispositions of the communicators. In this article, we explore these divergences using the example of need for cognitive closure (NCC). NCC affects how people communicate: how easily they accept new ideas and interpretations, how firmly they maintain their a priori positions, etc. In the end, this can affect how satisfied they are with both the process and the outcome of their communications with others. Our analyses were conducted within the framework of the Dynamical Negotiation Networks (DNN) model (Jochemczyk and Nowak, 2010), which allowed us to formalize the dynamics of the process of communication and its influence on the ultimate structure of the common ground that was reached.

Abbreviations: NCC, need for cognitive closure; DNN, Dynamical Negotiation Networks.

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1.1. Common ground

The process of communication requires mutual understanding, not only in the technical sense of "Did I understand the words that were said?" but also in the sense of "What did my interaction partner have in mind, saying those words?". Interaction partners formulate images of what the other side knows about the issues being discussed and about the areas of knowledge (and ignorance) of the other side (Cooley, 1902). This is how "common ground" (Clark and Brennan, 1991) – a shared representation of reality (Hardin and Higgins, 1996) – is created. Common ground is the shared knowledge, beliefs and assumptions (Clark and Carlson, 1982; Clark and Marshall, 1981) that constitute the basis for understanding reality as well as making judgements about the issues represented, and making decisions (Clark and Brennan, 1991).

Creating common ground is a dynamic and complicated process whose timeframe is difficult to determine. The interaction, as it proceeds, follows various pathways, engaging new information that enriches and changes the common ground (Clark and Brennan, 1991). The dynamic of this process depends on the goals of the interaction, on particular acts of communication, and on the medium that is used to communicate (Clark and Schaefer, 1989, 1987; Clark and Wilkes-Gibbs, 1986; Isaacs and Clark, 1987). That is why common ground is continually being negotiated throughout an interaction.

In order to create common ground, each interlocutor must achieve two fundamental goals: to understand the interaction partner, and to be understood by the interaction partner. How is this done? According to the model proposed by Clark and Schaefer (1989), communication acts have two phases: first one side presents some kind of content (wanting it to be understood) then the other side responds, either confirming that he or she understood, or denying understanding. Presenting content is done by uttering it. For example, one person says to the other, "You look nice today." By uttering this sentence, the individual has presented her content. Now, she needs the other side to indicate whether the communication was understood. This can be done in a number of ways: assent ("Oh, thank you!"), inquiry ("I look what today?"), going a step further ("You too!"), referring to the utterance, and so on. The essence of these communications is confirming that the utterance was understood, or indicating that it was not. As the interaction continues, the utterances and the connections between them create a network. Thanks to this procedure, a broad space of mutual understanding is established. This example is very simple, but the mechanism itself concerns many different and more complicated discussions, in which creating a shared set of concepts and knowledge does not seem so obvious.

1.2. Negotiation

Negotiations constitute a distinctive form of communication, making them useful for research on communication for several reasons. First, negotiations might be conducted between people who have differing perspectives and representations of the negotiated issue. This forces them to work out a shared understanding. Second, the aim of the negotiation is to make a shared decision on the negotiated issue (Arvanitis, 2015; Arvanitis and Karampatzos, 2013; Jochemczyk and Nowak, 2009, 2010). Third, apart from their overt aims, the negotiators have hidden aims, such as those connected to creating a self-image (for example, as an expert in the field), or establishing a long-term relationship with the other side (for example, as a business partner). Thus, they might wish to be understood in a way that is not reflective of their actual aims. Fourth, the sides often have interests that make it disadvantageous to change their representations of the issue, at the same time as such a change might be necessary to come to a shared decision. Fifth, the sides want (or at least pretend to want) to come to an understanding on at least the critical points. That is, they might not agree on all issues, but in order that the negotiations end successfully, they have to at least come to an agreement on the key issues surrounding the decision being made. Sixth, if the negotiators want to get a better result, they must increase the quality of the communication by conducting talks in such a way as to understand the needs of the other side, even if those needs are not explicitly stated. Thus, in order to achieve success in negotiations—that is, an agreement—it is necessary to create common ground, which will then serve as a basis for the agreement. It is not necessary that this common ground encompass the whole truth as both sides see it, but at least those elements that must be mutually agreed upon must be similarly defined among the negotiators. Thus, negotiations provide an excellent example of communication in which common ground is established, where we can observe the process of establishing it, and where we can analyze how the formal characteristics of creating common ground relate to the quality of the agreement and satisfaction with the process of the talks.

In negotiations, we can theoretically distinguish the objective result of the process of communication (the outcome) from the subjective satisfaction with the outcome and with the process of communication. These distinctions are not always made in practice, but their unique determinants and consequences have been demonstrated (e.g. Hollander-Blumoff and Tyler, 2008). Moreover, it is possible to attain a win-lose result, in which only one side's needs are met, a win–win solution (both side's needs are met), or a lose–lose result, in which neither side's needs are met (Fisher and Ury, 1981; Lewicki et al., 2010; Walton and McKersie, 1965). Based on the outcome, we can identify whether the process of creating common ground was beneficial for one side or for both or for neither. Additionally, we can separate task-related satisfaction (achieving a specific negotiation outcome) from satisfaction related to the interaction with the negotiation partner (procedural satisfaction) (Deutsch, 2006, 2011).

These three end results of negotiations (the outcome, outcome satisfaction, and process satisfaction) are related but distinct constructs and can be measured separately. Therefore, we can determine how specific characteristics of the process of communication influence each of these three results separately and in interaction. This makes negotiations a type of communication that lends itself particularly well to research.

1.3. Need for cognitive closure (NCC)

The process of negotiation is affected by contextual (situational) factors, such as the topic under discussion, or the medium through which discussion takes place (Purdy et al., 2000; Sheffield, 1995) as well as by person factors, that is, the characteristics of the negotiators themselves (Elfenbein, 2013; Elfenbein et al., 2008). It is widely accepted that what distinguishes outstanding negotiators from failed ones are personal characteristics, although research results are not entirely univocal on this issue. Some studies indicate that the effect of personality traits is negligible next to situational factors (Bazerman et al., 2000; Greenhalgh et al., 1985; Hosmanek and Mccormick, 2014), while others indicate that better measures of personality demonstrate greater impacts on negotiation (Barry and Friedman, 1998; Elfenbein et al., 2008; Maw Der Foo et al., 2004). Many individual differences affect negotiations: personality or temperament variables, differences in levels of verbal communication skill, etc. One psychological dimension that affects the process of negotiation is NCC (Kruglanski and Webster, 1996; Webster and Kruglanski, 1994, 1997).

NCC can be considered an individual difference or as a situational variable (Webster and Kruglanski, 1994). As an individual difference, it is the level of a person's intolerance for ambiguity or lack of clarity. As a situational variable, it is stronger in conditions such as haste, stress, or limited access to information (De Dreu, 2003). This means that a person whose NCC is generally low can, when tired or under stress, have a higher NCC and act accordingly. Regardless of its source (internal or external), a high NCC favors fast decision making and use of heuristics, and negatively affects tolerance for difference or ambiguity (Kruglanski and Webster, 1996; Webster and Kruglanski, 1994, 1997).

NCC consists of two cognitive processes: 1) information gathering, or "seizing", and 2) solidifying cognitive structures, or "freezing" (Kruglanski and Webster, 1996). In the "seizing" phase, an individual is open to new information and can gather various data from the surroundings; the schema, or cognitive structure, is still very flexible. In the "freezing" phase, an individual does not seek out new information but finalizes the cognitive structure that will, thereafter, no longer be so flexible. The duration of these phases varies. Individuals who have a high NCC tend to avoid the ambiguity that is characteristic of the "seizing" phase and "freeze" as quickly as possible, for the cognitive clarity it affords. From the perspective of negotiations, of course, this issue is not so simple. Apart from data gathering, the "seizing" phase also includes organization of information. During communication, the structure of the relationships between various elements can be of critical importance to reaching a common understanding of the situation and, in turn, to the outcome of negotiations. One of the most effective methods of reaching a win–win solution is exchanging compromises on different dimensions, that is, working on the relationships between different dimensions.

The influence of NCC on the process of negotiation can be observed on a number of levels. First, people with a high NCC tend toward more schematic information processing, are more likely to use heuristics, which shorten the time needed for analysis and decision making, but can lead to an incomplete picture of the situation (De Dreu et al., 1999; Dijksterhuis et al., 1996; Kruglanski and Freund, 1983). Second, although people with a high NCC function very well with clear, simple, or familiar problems, they might have difficulties with constructing mental models that include many dynamic interdependent variables. This means that they might prematurely want to end discussions (Bukowski et al., 2012). Third, a high NCC can lead people to make conclusions on the basis of incomplete information. Quick inferences can lead to incorrect conclusions (Kruglanski and Webster, 1996). Fourth, people with a high NCC have a tendency to seek and quickly attach significance to information that is consistent with their existing beliefs (De Dreu et al., 1999).

Schematic information processing, quick inferences, a disinclination to construct complex, dynamic models, and quick attachment to them all benefit short discussions. In negotiations, NCC therefore can be seen as potentially leading to quick (perhaps premature) conclusions or decision making. Of course, there can be many and various reasons behind quickly ending discussions or coming to a fast decision. Moreover, NCC has been associated with an ability to disregard irrelevant information (Kossowska, 2007), which might lead to correct solutions. Whatever the cause, the process of communication should be shorter when NCC is high than it would be otherwise. When NCC is low, the communication process should be longer. While a low NCC does not guarantee better solutions, it does appear that the duration of a negotiation is a significant factor that increases the chances of getting to an optimal solution (De Dreu et al., 1999).

In this article, we demonstrate how common ground is constructed, and we reveal the dynamics of its creation in two cases, with high and low NCC. Theoretically, individuals with a high NCC should resist changing their existing mental structures, defending their own representations of reality (De Dreu, 2003). Conversely, people with a low NCC should more easily accept ideas and proposals from their interlocutor. These differences should have an impact on the dynamics of the negotiation talks, the structure of the final common ground, and the negotiators' satisfaction with the interaction, both in terms of the outcome and in terms of their subjective evaluation of the process of communication.

We focus here on the way in which NCC might manifest in the complexity of the structure of the common ground between negotiators. We propose that low NCC should allow negotiators to create large and/or complex structures with many connections and interdependencies between elements. A high NCC, on the other hand, should lead to networks (structures) with few elements and/or few connections between them.

The role of NCC in negotiations can be determined through appropriate research. To date, this has not been done, perhaps due to a lack of adequate formal methodology. This obstacle is overcome with the Dynamical Negotiation Network model proposed by Jochemczyk and Nowak (2010). This model represents the way a shared reality, or common ground, is arrived at during a negotiation, through a dynamically constructed semantic network.

1.4. The Dynamical Negotiation Network model

The Dynamical Negotiation Network model (DNN; Jochemczyk and Nowak, 2009, 2010) explains, or conveys, the process of communication in negotiations as a semantic network. According to the assumptions of this model, the negotiators (interlocutors) build a shared reality, or common ground, during their interaction (Ahn and Yap, 2013; Clark and Brennan, 1991; Hardin and Higgins, 1996). This common ground is represented in the DNN as a semantic network that changes (nodes and connections are added, change value, etc.) as the interaction proceeds. Thus, the DNN is a special case of class of complex adaptive networks (Gross and Sayama, 2009; Sayama et al., 2013). At any given moment of the interaction, the network reflects the state of the shared reality for that moment. Adding new elements, or changing existing elements, influences other elements of the network; that is, changes in one part of the network can provoke changes in other parts. Thus, the DNN dynamically changes over time, precisely reflecting the changing understanding negotiators have of their common ground. The DNN model was proposed originally to aid in analyzing the communication process in negotiations, but can be used to represent any verbal communication process (Jochemczyk and Nowak, 2010).

The DNN model assumes that building common ground is an interactive process that is reflected in the dynamics of network construction (Jochemczyk and Nowak, 2009). Anything that is uttered is part of a common network, without distinction between what is shared and what is individual. The network is therefore a de facto transcription of the interaction, ultimately structured in a way that illuminates which elements were contentious and required elaboration and which were not under debate.

The DNN model and the way it translates the negotiation process into a network has been described in detail elsewhere (Jochemczyk and Nowak, 2010). In the second part of this article, we illustrate the ways negotiators who are high in NCC or low in NCC construct a DNN. Here, we outline the basic steps of the procedure. The process of translating a negotiation into a network is a qualitative procedure performed by trained coders. As a coder follows the interaction, he or she must identify two basic types of elements: facts/objects, and the relationships between them. In the terminology of the DNN model, these two types of elements are nodes and connections. Nodes represent statements, facts, or other issues under discussion, while connections represent the relationships between these statements, facts, or issues. For example, a node in a negotiation might be the price of a given product, another might be its quality. An utterance referring to the relationship between these—for example, that high quality can only be achieved with a high price tag—would be a connection. We describe these elements below, but readers interested in greater detail will find them in Jochemczyk and Nowak (2010).

1.4.1. Nodes

If the sides in a negotiation want to discuss a fact or issue, they must first introduce the issue to the network, creating a node. Then they can go on to define, change, or confirm the value of the node through subsequent utterances or connections with other nodes. Each node is characterized by a certain value analogous to an activation level in neural networks (Kunda and Thagard, 1996; Rumelhart, 1986). This value codes the truthfulness of each statement, or the intensity of a given issue (e.g., the amount of money in a "money" node, or the intensity of color in a "green" node). Nodes can have values between 0 and 1 or between -1 and 1. The first range is used for coding truthfulness of nodes, or the value of unipolar nodes (0 is lack of a given characteristic, 1 is full saturation). The -1 to 1 range is used for coding nodes whose properties can have semantically opposite meanings (e.g., good vs. evil, green vs. red) or nodes that are bipolar (e.g., "price" coded positively means that person A will pay, while a negative code would mean that person B will pay).

1.4.2. Connections

If the sides are discussing the relationships between facts or issues, they can be asserting that the issues are related positively or negatively, or that the issues are unrelated. If the issues are related positively, the occurrence of one will be accompanied by the occurrence of the other (e.g., high quality is accompanied by high price). A negative relationship indicates that the occurrence of one will be accompanied by the absence of the other (e.g. high quality is accompanied by a lack of malfunction). Unrelated issues are those where the occurrence of one tells us nothing about the occurrence or absence of the other (e.g. high quality and color might not be related in any way). Relationships can vary in strength and in direction. The strength of connection can theoretically take on values between minus infinity and positive infinity. Direction can be one-way or two-way. One-way connections mean that we can predict from issue A the occurrence of issue B, but issue B will not tell us anything about the occurrence of issue A. Two-way connections mean that the occurrence of each is informative with regard to the other.

1.4.3. The functioning of the network

Theoretically, many connections are possible between nodes, depending on the issue that is negotiated. All connections that are introduced into the network send signals between the nodes they connect and in this way affect their values. When a single node is connected to many other nodes, its value will be the total of all signals it receives from all of those others nodes. The influence of one node on another is the product of the value of the originator node and the strength of the connection. For example, if a node receives signals from two other nodes whose values are $+1$ and -1, whose connection strengths are identical, the value of the recipient node will be zero.

1.4.4. Disagreement between negotiators and network structure

Negotiators conduct their talks intuitively, in whatever way makes sense to them. Particularly when negotiators are not experienced, the networks they construct are the result of their natural interaction styles. The structure of the network will reflect the agreements and disagreements that negotiators encounter.

If one side introduces an issue (a node), and the other side does not agree with its value, this disagreement can be expressed in one of two ways: 1) by introducing a new node that will negate the value of the contentious node; or 2) by introducing a new connection to an existing node that will negate the value of the contentious node. Both cases have the same effect: the value of the contentious node is changed. If the sides still do not agree on the value, the process can continue with the first side introducing another node or connection, and so on, until some balance is reached. In this way, issues on which there is disagreement become elements of common ground, and the disagreement about them is embedded in the network.

Changing the value of a node by introducing a new element into the network has the effect of increasing the connections that go into the disputed node. Thus, the more incoming connections a node has in the ultimate network structure, the more disagreement there was regarding the issue it represents. A lack of incoming connections indicates that the negotiators did not feel the need to discuss the value of the node; that is, they either agreed on its value, or the issue was not important enough to dispute.

The final structure of the network is a function of several processes that take place during an interaction. First, there are issues that the two sides want to reach an agreement on in order to achieve their negotiation goal. Second, there are nodes and connections that are introduced in order to justify (changes to) the values of existing nodes. Finally, there are nodes and connections that the sides do not spend time on because they are not prioritized or because the discussion ends before they can be elaborated. Thus, the ultimate common ground consists of issues that were understood similarly from the outset, and those whose meaning or value had to be arrived at through interaction. Thanks to this structure, we can see which issues are a source of conflict and who convinced whom of what.

1.4.5. Coding the negotiation network

The structure of the network (common ground) created by interlocutors can be analyzed at a number of levels of generality/specificity. The same utterance can be coded on a very specific level, using a number of nodes, or on an general level, using one, more abstract node. For example, a farmer discussing what crop he would like to plant might consider the issue of the profitability of a particular crop. This can be represented as a single node, such as “profitability”. This same issue can be represented as number of more specific nodes that are connected to each other. For example, “labor intensity”, “ease of storage”, “frost resistance”, “water needs”, “fertilization needs”, and so on. Each issue can, theoretically, be divided into an infinite number of lower-level nodes. The connections between these lower-level nodes, as well as to the other nodes in the network, can become quite complicated. Thus, the more abstract our network representation, the simpler it is to interpret, but the less useful the interpretation. At the highest level of abstraction, any conflict can be represented as two oppositional nodes, but such a representation will not let us draw conclusions about why the sides are in conflict or how they see the relationships between aspects of their conflict. On the other hand, the more specific a representation, the easier it will be to recognize the real interdependencies between issues, but the more complex the network will be.

Thus, the coding procedure in such research necessarily balances the goals of a true representation versus an easily interpretable representation. A decision about the level of coding must be made before a negotiation is translated into a network. In our research, we code at a low level of abstraction. Our coders are instructed to include as many nodes as they consider necessary, when in doubt adding new nodes rather than assuming that a new issue fits into an existing node. Although time-consuming, this narrows the range of individual coders’ interpretations of what is more or less important in a negotiation, which increases the reliability of the coding process.

2. Empirical illustration

Here, we present an empirical illustration of these negotiation networks based on two negotiations. One was conducted between two high NCC individuals, the other between two low NCC individuals. These two negotiations were part of a larger study in which 38 pairs of individuals (38 men and 38 women) aged 19–32 years ($M = 22.0$; $SD = 2.2$) participated. They were recruited through social media sites on the internet for a study on negotiations. All of the participants lived in Warsaw and were current students or recent graduates.

Participants were pre-selected for this larger study based on scores on the abridged NCC scale (Kossowska et al., 2012; Cronbach’s $\alpha = .698$ in our sample), which they filled out online. This scale comprises two factors: motivation to make quick decisions, and motivation to create and maintain simple structures in one’s mind (Kossowska et al., 2002; Neuberg et al., 1997). These are factors that we considered would affect the dynamics and structures of negotiations: the former, because it would lead to consideration of fewer alternatives, and the latter because it would lead to resistance to incorporating the other side’s different judgments about negotiated issues. Based on their responses to the abridged NCC scale, participants were assigned to a low NCC group (scores in the lowest 25% of the distribution, $M = 45.0$, $SD = 3.4$, where scores could range from 15 to 90) or a high NCC group (scores in the highest 25% of the distribution, $M = 62.1$, $SD = 3.0$).

Static analyses of the relationship between NCC and outcomes of these negotiations have been previously published (Pietrzak et al., 2014). In this article, we show qualitative network analyses of the dynamics of constructing common ground by a pair with a high NCC, and a pair with a low NCC.

2.1. Procedure

The selected participants were invited to come to the lab for an hour-long in-person negotiation study for which they would be paid 15–20 PLN depending on their negotiation outcome (in fact, all participants were paid the maximum amount, 20 PLN, approx. 6 USD). Participants were paired with a same-gender partner of the same NCC level (high or low). In the lab, they first read the negotiation scenario. Second, they filled out a questionnaire about their perception of the other negotiator, their attitude towards the process, their expectations, and preferred results. Then, the two sides negotiated. Participants were informed that on average a negotiation takes about 15 min, but they were not given a time limit. In all cases, the negotiations ended when negotiators came to an agreement. The negotiation was video-recorded. After the negotiations, participants were separated and watched the recording of their negotiation. While watching, they rated their moment-to-moment NCC (to what extent they wanted to continue vs. end the negotiations at that moment) using a mouse-paradigm procedure (Vallacher et al., 1994). After this procedure, participants filled out a second questionnaire, in which they assessed their procedural and distributive satisfaction, their perception of the other negotiator, their perception of the process etc. Finally, participants were thanked and received payment for participation.

2.2. Negotiation scenario

The negotiations concerned opening a business growing organic vegetables. The negotiators were neighbors with adjacent gardens. They had a number of issues to discuss with regard to initial contributions to the business: financial input, how much of each garden was to be used, how much labor each could devote to the business over the coming months, and what to plant. The first three dimensions (money, garden plot, and labor) were translated for each negotiator separately into points that would be used to determine their ultimate payment for participation (though in fact, all participants received the maximum possible payment). The last dimension, what to plant (tomatoes or carrots) was not worth any points, but was a point of contention because the negotiation scenarios contained conflicting information about profitability. An integrated solution was possible, as was a 50–50 split. The negotiation scenario is included in the Appendix.

2.3. Analyses

We analyze two negotiation networks that were created based on transcripts of two dyadic negotiations. The transcripts were translated into network structures by two trained coders, who independently coded each and then reconciled discrepancies through discussion. We will show illustrative examples of a high-NCC negotiation and a low-NCC negotiation, chosen for their prototypicality (representativeness) for the studied groups. In the Results section, we show how these networks were constructed and note their structural and temporal characteristics. Here we outline measures used to describe and compare negotiation networks. More on these measures can be found in Wasserman and Faust (1994).

2.3.1. Network indicators

A number of indicators can be used to describe the structure of a network. These measures can tell us something about the specific elements of the network, or about the network as a whole. The basic indicators of the significance of particular issues focus on: a) how central a node is in the network and b) the extent to which that node controls signals passed through the network by other nodes.

The first of these indicators, centrality, can be understood as the sum of connections a node has, or its *Degree*. *Degree* can be broken down into *InDegree* (a measure of incoming connections) and *OutDegree* (a measure of outgoing connections). The average Degree that nodes in a network have tells us about *Network Density,* which is calculated by the number of nodes divided by the number of connections in the network. An alternative measure of a node's centrality is *Closeness*—a node's distance to other nodes (how many other nodes a signal coming from it would have to go through to get to any particular node in the network). The higher a node's Closeness, the lower the distance that separates it from other nodes, globally. A node with the greatest possible value of Closeness will be a 'star' type that is directly connected to all other nodes in the network.

The extent to which a node controls signals is *Betweenness*, which is a measure that indicates the extent to which that node lies along the shortest possible paths between other pairs of nodes. The more of these shortest paths a given nodes lies on, the greater its Betweenness.

A network can be analyzed as a structure of connected nodes either taking into account directionality of connections (termed a directed network) or disregarding directionality (an undirected network). Some network indicators can differ depending on whether the network is analyzed as a directed or undirected one. For example, the distance between node A and node B is measured by the number of connections needed to get from one to the other. Two nodes can be closely connected (with one single node C between them) in an undirected network, while their distance can be infinite (undefined) in a directed network (if node C has only incoming connections). Closeness and Betweenness indicators can therefore be quite variable in directed networks.

The indicators described above can be calculated for each node in the network. Using the outcomes of these calculations, it becomes possible to calculate the distribution of each indicator for the network as a whole. This is called *Centralization.* The more equal the distribution of a given indicator is, the lower the network's Centralization. Thus, if we know the Degree,

Closeness, and Betweenness of each node in our network, we can calculate *Degree Centralization, Closeness Centralization,* and *Betweenness Centralization* to describe the network as a whole.

Other indicators of network structure exist (Wasserman and Faust, 1994), but the ones given here are sufficient to describe the networks we studied.

3. Results

We present the results below for two networks, one analysis representing a high NCC pair, and the other representing a low NCC pair. Network analyses were performed with R and the SNA package (Butts, 2008; Ripley et al., 2014).

3.1. Rate of network construction

We look first at the dynamics of network construction over the course of the negotiations as a whole. Each negotiation was divided into five stages to simplify analyses of structural change in the network. Divisions were made so that the stages contained a more or less equal number of words (in the written transcription of the negotiation). No negotiator's utterances were divided, however, so this criterion was not strict. Previous studies have demonstrated that this is a good way to divide negotiations into stages (Jochemczyk and Nowak, 2009).

Fig. 1 shows the number of nodes introduced into common ground in each negotiation stage. Fig. 2 shows similar data for links made between nodes. In both cases, sides start introducing nodes and connections from the beginning of the negotiation and this process gradually slows down toward the end of the negotiation.

3.2. Negotiation network structure over time

Fig. 3 shows the final network structure produced by the negotiators with a high NCC, while Fig. 4 shows the final structure for the pair with a low NCC. The nodes that were introduced in each stage of the negotiation are presented in separate boxes. No new nodes were introduced in the fifth stage of negotiations.

When graphically represented, positive connections are drawn with a solid line, and negative connections are drawn with a dotted line. Strength of connection is designated by thickness: the stronger the connection, the stronger the influence and the thicker the line. Similarly, a node with a positive valence is surrounded by a solid line, while a negative node is surrounded by a dotted line. Again, the value is coded by the thickness of the line—the thicker the line, the greater the node's value (whether positive or negative).

After the first stage of the negotiation, the structures of the networks look similar. There are a few more nodes and links in the structure for the low NCC pair, but the structures themselves do not differ substantially.

After stage 2, the low NCC pair has three separate segments, or components, of a network. The smallest component has only two elements, and will be developed in stage 3. The high NCC pair, meanwhile, has only one major component, and one single node unconnected to it.

In the third stage, the differences between the networks are maintained. The low NCC pair's negotiation network has three separate components of similar sizes, while the high NCC pair's one component continues to grow (and the lone node remains unconnected to any others).

In the fourth stage of negotiation, the low NCC pair's network has three components, of which two are 10 nodes in size, unchanged from stage 2, and the third has grown from 9 to 17 nodes. The links in this last component have risen from 17 to 27 (the network as a whole now has 57 links) while the other two components have not changed. In this situation, the negotiators are focusing only on the fragments of the network that are currently under discussion—the other parts go unmentioned. In the high NCC negotiation, the number of nodes increased by 8 (to 41), and the number of links rose by 8 (to 60). The network remains one large component, plus two solitary nodes that have no links to any others.

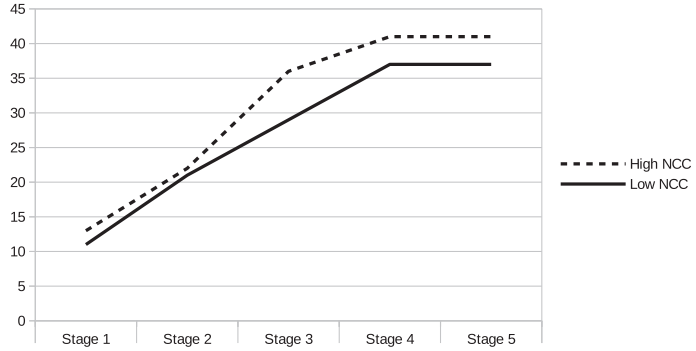

Fig. 1. Total number of nodes in the network in consecutive stages of the negotiation.

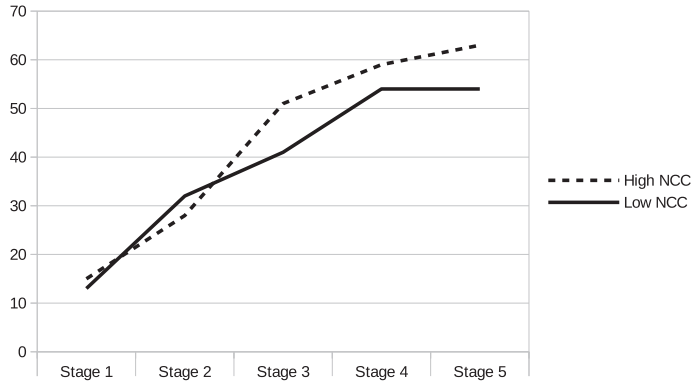

Fig. 2. Total number of links in the network in consecutive stages of the negotiation.

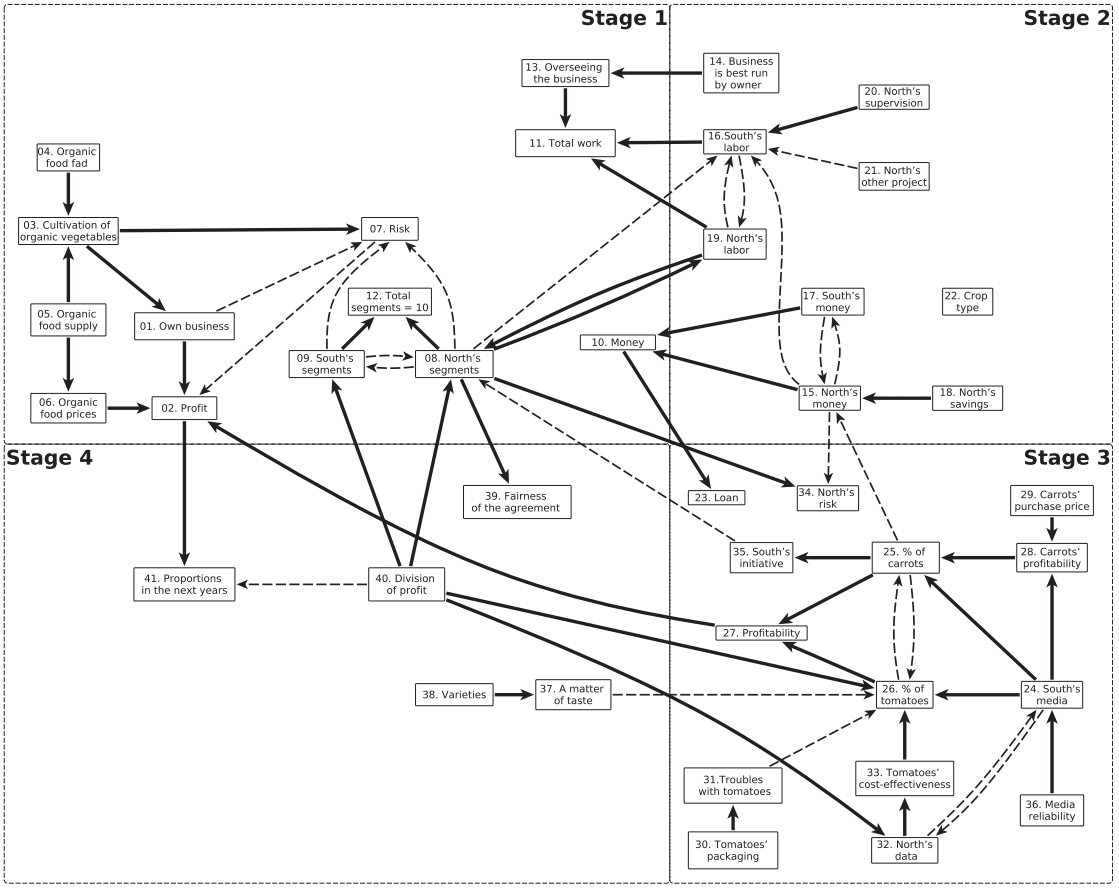

Fig. 3. Final structure of the negotiation network constructed by high NCC negotiators.

In the final, fifth stage, low NCC negotiators did not change the structure of the network at all; no new nodes or links were added. The negotiation concerned only the values of the existing nodes. The high NCC negotiators added four new links between existing nodes in this last stage.

3.3. The final negotiation network structure

In its final form, the low NCC network contains three separate components of similar size, while the high NCC network is one large component. This latter network is one in which elements are connected in a complicated way, and there are paths (regardless of directionality) connecting pairs of all nodes. Within the former network, nodes in each of the three components

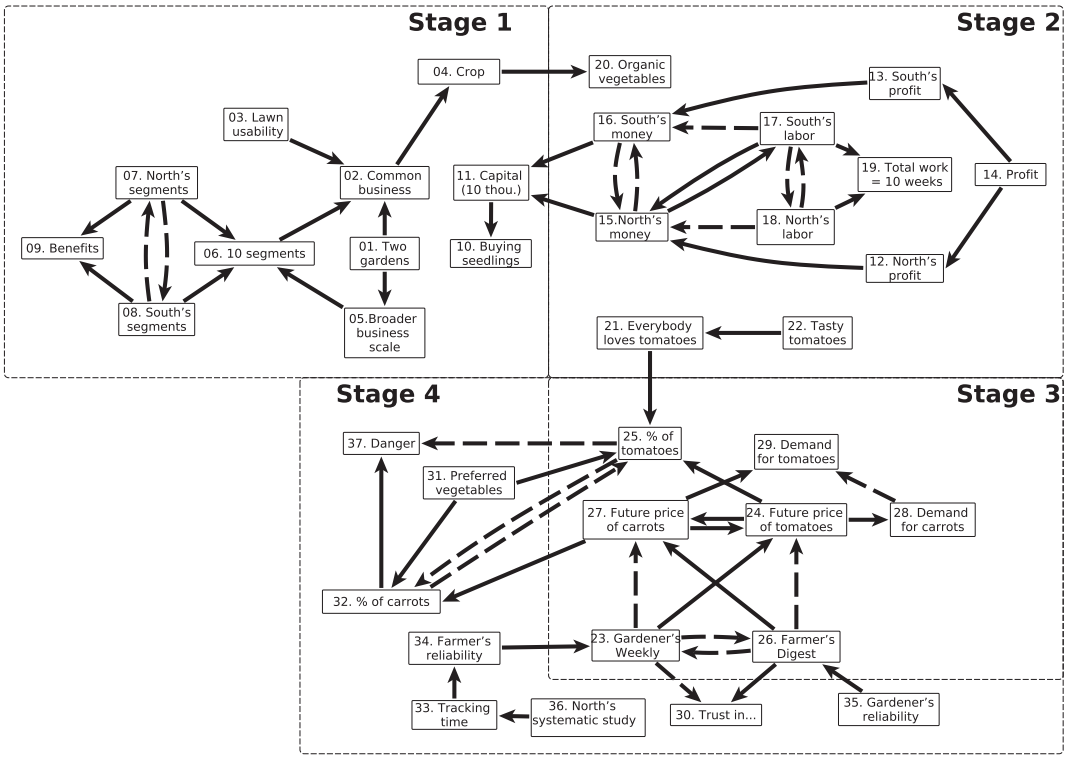

Fig. 4. Final structure of the negotiation network constructed by low NCC negotiators.

are connected in a much simpler way—this is exemplified by the fact that one can draw the network in such a way that links between nodes do not intersect (see Fig. 4), and the nodes are situated quite close to each other. The same method of situating nodes in the high NCC network gives a much more complicated representation (see Fig. 3). In the following paragraphs, we show how these differences are reflected in the network measures and indicators outlined above.

We calculated the indicators described in the Analyses section (2.3) to describe the two networks. We assumed directed networks in the results presented here. However, analyses conducted with undirected networks gave similar results.

The densities of the networks were similar. Representing density as the average Degree, i.e., density per node, shows that the high NCC network had a density of $k = 3.02$, while the low NCC network had a density of $k = 3$. This means that the nodes in both networks had an average of about 3 links each.

The two negotiations were not as similar on measures that reflect the complexity of connections in the networks: Betweenness and Closeness. Most networks we encounter in everyday life (Albert and Barabási, 2002), including semantic networks (Steyvers and Tenenbaum, 2005), have power-law distributions. This is also true of negotiation networks (Jochemczyk, 2008). For this reason, it is worth considering not only mean values but also measures such as minimums, maximums, medians, and sums of all values.

We calculated the Betweenness (the extent to which a given node 'controls' the signal flow between other nodes) of all the nodes. For the network constructed by high NCC negotiators, the maximum Betweenness score was 169.00, while for low NCC negotiators it was 45.00. The means for Betweenness were 21.00 for high the NCC network and 6.83 for the low NCC network. The median Betweenness was the same for both: 1.50. A boxplot showing these results is presented in Fig. 5. These coefficients have very skewed distributions, with large differences between the maximum values of Betweenness in the two networks. In Table 1, we show results for Betweenness centralization, according to which the distribution of Betweenness for the high NCC network is more variable than for the low NCC network.

We calculated Closeness coefficients for all nodes (an indicator of the distance from a given node to all others). For the high NCC network, the maximum Closeness vale was .297, while for the low NCC network it was .162. The means for these coefficients for high NCC and low NCC respectively were .102 and .078, while the medians were .115 and .090. These boxplots are presented in Fig. 6. In Table 1, we show Closeness Centralization results that demonstrate that the Closeness distribution for the high NCC negotiation network is more variable than the Closeness distribution for low NCC negotiation network.

3.3.1. Network centralization

Measures of centralization reflect the distribution of the indicators in a network. The greater the Centralization coefficient, the greater the differences among the nodes and connections of the network; that is, the less uniform it is with regard to that

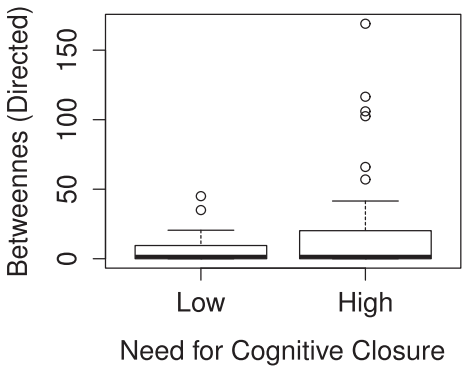

Fig. 5. Directed Betweenness for the networks created by negotiators with low and high NCC.

Table 1
Network centralization measures for the negotiations with low and high NCC.

	Degree	In Degree	Out Degree	Betweenness	Closeness
High NCC	.10	.09	.14	.10	.0050
Low NCC	.06	.07	.07	.03	.0025

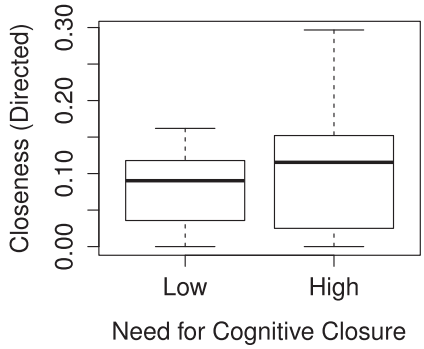

Fig. 6. Directed Closeness for the networks created by negotiators with low and high NCC.

indicator. In Table 1, we show the following indicators for the high and the low NCC negotiation networks: Degree, In Degree, Out Degree, directed Betweenness, and directed Closeness. For all of these, the network constructed by the high NCC pair of negotiators has higher values than the network constructed by the low NCC negotiators.

4. Discussion

In this article, we illustrated the process of building common ground between interlocutors. We analyzed negotiations conducted by two pairs of individuals—a pair with low NCC, and a pair with high NCC—to explore how they constructed a network of shared meanings. To perform these analyses, we used the DNN model (Jochemczyk and Nowak, 2010), which allowed us to translate a dyadic interaction into a developing semantic network. The results showed that while the number of nodes and connections in the networks (the size of the common ground) might be similar, the networks structures might differ in their complexity.

Although the NCC construct is one that has been studied in the social sciences for some time (Jaśko et al., 2015; Kruglanski and Webster, 1996), little is known about how it affects interactions. The construct is theoretically related to cognitive processes, yet most studies on NCC in fact investigate the outcome of those processes, not the dynamics leading up to those outcomes. This means that the kinds of conclusions that are drawn must be limited. Using methodology that allows us to look at network dynamics, we can make inferences about the information processing that leads to particular outcomes. This paper illustrates this procedure.

We looked at four main properties of networks constructed during a dyadic negotiation: 1) the rate of network construction; 2) the dynamics of network construction, including numbers of links, nodes, and components; 3) the final structure of the constructed networks; and 4) the degree of centralization of the networks.

The analyses indicated that the rate of construction and overall size of analyzed networks were similar for the two pairs. The two negotiating pairs introduced nodes and links into the network similarly. There were, however, differences in the way that elements were added: very early on, the low NCC pair had created a network comprising three separate components, while the high NCC pair ended up with a single-component network. These networks differed in their final form as well: the network of the low NCC pair had more components of which all had relatively simple, uniform structures of links, and therefore low coefficients of closeness, than the network of the high NCC pair. They, meanwhile, had a network with higher centralization indicators than did the low NCC pair, which means that their network had a more varied distribution of Centrality coefficients (Degree, Betweenness, and Closeness, both for directed and undirected analyses). This pattern, albeit shown just by one pair in each category, was contrary to our prediction that high NCC negotiators would create less complex structures than would low NCC negotiators.

The mechanisms leading to more complex structures of common ground that might result from cognitive closure are not clear. We can speculate on these mechanisms. For example, if I am convinced that tomatoes will be more profitable than carrots in the upcoming season, and my business partner believes that carrots will be more profitable, then I must present an argument that defends my position. In the terminology of the DNN model, making this argument is equivalent to adding a new node that is linked to tomatoes and increases its value. The other negotiator, in response, can add his or her own counterargument, or undermine my argument, by adding another node. I can then strengthen my argument or undermine the other side's. Unless one side decides on a concession, such a discussion could theoretically go on indefinitely, creating a network of interdependencies all linked to the tomatoes node. This would be less likely if both sides were more flexible. A weaker need to maintain one's own point of view might mean weaker motivation to argue for specific conceptualizations, and so a weaker intent to introduce new arguments defending that point of view. This might ultimately be reflected in a simpler network structure. These are processes that remain to be clarified in future research.

It is worth noting that NCC consists of two tendencies: seizing and freezing (Kruglanski and Webster, 1996), which refer to different processes. This is an important distinction because, as was shown by De Dreu (2003), creating urgency in a negotiation (prompting seizing) provokes heuristic thinking and limits the chances of attaining an integrated solution. In this study, we focused on NCC from the perspective of the need to maintain one's own structural representation of a given problem, which can be considered more in terms of the tendency to freeze. If we translate the concept of NCC into the DNN model, processes involved in freezing relate to a defense of the structure of one's own understanding. Seizing would refer to an increase in the rate of building a common network, or a premature halt to its construction. It might be that people of various levels of NCC (as an individual difference), subjected to the same time pressure, will construct different networks, though all of them might be incomplete. This is an empirical question to which the answer must be found in future studies.

In terms of how this tendency to permanence might affect communication, research we conducted on the same group of negotiators with high vs. low NCC (Pietrzak et al., 2014) showed that people with a low NCC declared a greater sense of seeking win–win (integrated) solutions during the negotiations than did people with a high NCC. This result can be interpreted in reference to the processes of building common ground found in the pairs described here. We propose that negotiators with a low NCC were less likely to oppose developments to the network structure proposed by their interlocutors than were negotiators with a high NCC. Since the number of connections in the two networks was not significantly different, we can infer that the low NCC networks had a less complex structure, in that there were fewer mutual oppositions between nodes. This ease in construction of the network apparently translated to a sense of cooperativeness in the negotiation, despite the groups not ultimately differing in their achievement of integrated solutions.

A low NCC might generate fewer problems agreeing on the individual values of nodes, and connections between them, and this relative lack of local conflicts can result in less need for debate and, in consequence, smaller networks. For people of high NCC, meanwhile, it might be unpleasant to build large networks due to the need for resolving local conflicts, but this might be necessary in order to maintain their original representation of the negotiated issue. This will result in a greater number of nodes and connections in the common ground. A study that would illuminate these processes could be one in which people of various levels of NCC have conflicting information about issues that are more or less important to their outcomes. This would allow us to determine the conditions in which larger or smaller common ground networks are constructed. It is possible that low NCC negotiators would be more easily distracted by irrelevant connections when interacting with skilled negotiators, while those with a high NCC would be more able to navigate around such distractions to come to the solution they seek.

Another question worth investigating in future research concerns the relationship between the structure of networks, and the dynamics of constructing them, vis-a-vis better or worse (more or less integrative) objective outcomes and subjective experiences (e.g., trust in the negotiation partner, satisfaction with the outcome). Moreover, it is possible to investigate how the change in mental representation of an issue changes through the negotiation process (and NCC could be taken account in predicting such changes). Everyone who enters a negotiation does so with certain expectations with regard to the important issues and the connections between them. It is likely that the negotiation process changes this pattern of interdependencies, perhaps more so for individuals low in NCC. This remains to be tested.

We believe that the analytical procedure outlined here provides interesting and important new indicators to describe the process of communication. Nonetheless, this paper is foremost an illustration of method, rather than an investigation of a psychological phenomenon. For the purposes of this paper, we selected two pairs from our sample, one of low and one of high NCC participants, to serve as a demonstration of the DNN method. These pairs might not be representative for all the high and low NCC cases and so generalizability should not be assumed. Analyses should be conducted on other negotiation networks, even from within our sample, in order to demonstrate reliability. Including other samples, perhaps made up of individuals

with greater negotiation experience, would also increase the faith we have in our conclusions. Additionally, the negotiation scenario was quite artificial—it will be important to study the construction of a negotiation network among people who are experienced and for whom the issue has real-world significance.

A fundamental issue with network analyses is that the construction of the network itself (determining what constitutes a separate node, how connections should be drawn, etc.) is subjective. The coder must be trained but must also use his or her intuitions with regard to identifying a node as positive and the connection as negative, or vice versa. In this study, each network was independently constructed by two trained coders, who resolved inconsistencies through discussion. This brings us closer to objectivity, but is not enough to fully satisfy standards that would guarantee the reliability of our conclusions. This issue is of course not limited to our study, but concerns network analyses and qualitative approaches more broadly.

5. Conclusions

In this paper, we presented an analysis of the construction of a shared, common ground in two dyads of negotiators. The communication process of the negotiators affected how they built the semantic network that they then used to make decisions and come to an agreement. In two analyzed cases, we revealed that although the sizes of the networks of common ground of the low NCC and high NCC negotiators were similar, the interconnectedness of these networks was different. Thus, the complexity of such networks may vary independent of size. In this way, we demonstrate that the DNN model is a good tool to represent and analyze the dynamics of the creation of common ground as well as its final structure.

Acknowledgments

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Appendix. Negotiation scenario

Negotiation script. Bold text indicates information provided to the south neighbor; text in italics indicates information provided to the north neighbor. Scripts were written to match the gender of participants.

South neighbor/*North neighbor*

You have been thinking about opening up your own business, growing and selling organic vegetables, for some time. You would need a large plot of land for this, so you have started talking to your neighbor to discuss going into business together. If you join your (adjacent) yards, you will have enough land to start a viable business. To open the business, you will also have to split the costs of purchasing seedlings and necessary equipment and installations (fence, irrigation, etc.). Furthermore, you will have to divide the labor involved in this enterprise (how many weeks are needed to get the garden going). Finally, you will have to decide what to plant (which might be most important). You have decided to split the profits 50–50, regardless of investments.

The specific conditions of your agreement can be translated into points. The more points you have at the end of the season, the better. These points will let you determine your preferences for various solutions.

Your yard is 1000 m^2, divided into 10 equal segments. You can devote up to **9 segments/***9 segments* to the business. To open the business, you will need 10 segments in total. For each segment LESS than 9 that you devote to the business, you will receive **1 point/***2 points*. If your neighbor provides the whole land necessary, you will receive **9 points**/*18 points*. If you each provide 5 segments, you will get **4 points**/*8 points.* If you devote your 9 segments to the business, you will not get any points.

You have estimated the cost of seedlings and other equipment to be 10 thousand PLN. The maximum you can invest is **8 thousand zł**/*6 thousand PLN*. For each 1 thousand PLN you invest LESS than that, you will receive **1 point**/*2 points*. Thus, if you invest nothing and your neighbor pays the full 10 thousand you will get **8 points**/*12 points*. If you split the costs 50–50, you will get **3 points**/*2 points*. If you spend all of your money, you will not get any points.

You have estimated the amount of labor necessary to get the business going to be 10 weeks. **You have various plans for the spring-summer season, so you can spend up to 6 weeks on the business, but you would prefer not to spend any time on it at all**. *You have no particular plans for the spring-summer season, so you can spend a full 10 weeks on the business*. For each week FEWER than **6 weeks**/*10 weeks* you will receive **8 points**/*1 point*. Thus, if your neighbor does all the work, you will receive **48 points**/*10 points.* If you split the labor 50–50, you will receive **8 points**/*5 points*. If you devote all the time you have to the business, you will not get any points.

Your vegetable garden will be divided into 10 standard segments, on which you can plant various vegetables. You have decided to plant either carrots or tomatoes. These two crops currently are likely to provide the same profit. However, in **the Weekly Gardener**/*Farmer's Weekly,* you have read that the price of **tomatoes**/*carrots* should be about 10% higher than it is now. The price of **carrots**/*tomatoes*, meanwhile, is unlikely to change. You remember that **the Weekly Gardener**/*Farmer's Weekly* has always been a good predictor of vegetable prices. Your profit ultimately depends on the future prices of the vegetables you decide to plant. If **tomato**/*carrot* prices rise by 10%, your profit will be 10% greater. If, on the other hand, the prices fall by 10%, your profits will be lower. You can plant **tomatoes and carrots**/*carrots and tomatoes* in whatever proportions you want in your garden, but your profit will depend on their future prices.

Your task is to negotiate the best possible terms of entering into this business with your neighbor. Take a moment to think about the points in this game, and think about reasons that might underlie your preference for some solutions over others. Remember that the total profit will be split in half between you and your partner, regardless of investments. Your final results will be the profit you make, plus the points you earn. The more points you earn, the better.

Summarizing, you need:

- Land → 10 segments. You can devote up to 9 – each segment less → **+1 point**/*+2 points.*
- Money → 10 thousand PLN. You can invest up to **8000**/*6000* PLN – each 1 thousand less → **+1 point**/*+2 points.*
- Labor → 10 weeks. You can devote **6 weeks**/*10 weeks* – each week less → **+8 points**/*+1 point.*
- Seedlings → what proportion of carrots vs. tomatoes you plant will ultimately determine your profit. According to **the Weekly Gardener**/*Farmer's Weekly*, the price of **tomatoes**/*carrots* will be higher this year.

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